

Development Strategy, Viability, and Economic Distortions in Developing Countries

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Abstract

This paper presents a three-sector static model to explore the rationale for a series of institutional distortions in developing countries. The authors argue that, after World War II, motivated by a belief in the development of state-of-the-art industries as a means for nation building, the majority of developing country governments attempted to accelerate the growth of advanced capital-intensive industries. However, since developing countries are relatively rich in labor or natural resource endowments but not in capital endowment, advanced capital-intensive industries were not adapted to the endowment structures of these developing countries at the time. Enterprises in those industries were non-viable in open,

competitive markets and could not survive without government subsidization or protection. The model shows that, in order to mobilize resources into the capital-intensive, advanced sectors, it is necessary for governments to use distortionary policies such as taxes and subsidies, distortions of factor prices, directive allocation of resources, and nationalization of enterprises. Such distortions enable developing countries to set up advanced, capital-intensive industries in the early stage of their development. However, they also tend to suppress incentives, misallocate resources, and make the economy inefficient.

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1. Introduction

Many distortions exist simultaneously in developing countries—such as preferential taxes and subsidies to certain industries, financial repression, over-valuation of domestic currencies, rationing of capital and foreign exchange, administration-created monopolies, and state ownership. These distortions often lead to poor economic performance, low living standards, and even frequent crises in developing countries. There is, however, no consensus about their origins.

Some economists have provided an “interest group” explanation (Grossman and Helpman, 1994; Sokoloff and Engerman, 2000; Acemoglu, 2007). This view emphasizes the economic or political benefits to particular interest groups from the distortions, and these groups have enough political influence to force the government to adopt distortional arrangements that are favorable to them. This view is insightful because powerful interest groups in developing countries are associated largely with capital-intensive, advanced sectors, which gain the most government protection. However, the view is inconsistent with the fact that at the time when the protections were first introduced, the most powerful interest group in many developing countries was the landed class. The protections hurt the landed class. Moreover, although the powerful industrial group gains from the protections, it loses from other distortions, for example, the widely observed state ownership in advanced industries in developing countries. Gordon and Li (2005a, 2005b) provide an alternative, “public finance” explanation that suggests that developing country governments’ regulation and distortions were designed to alleviate problems with tax collection. The authors argue that since there is a large un-taxable underground economy in developing countries, it is desirable for governments to mobilize resources to support the development of sectors that are easier to tax in order to increase government revenue. According to Gordon and Li, the observed protection of formal, advanced sectors is instituted for this purpose. They did not, however, explain why the government wanted to collect the taxes and how the tax revenue was used. In fact, in many developing countries, the taxes collected from the advanced, modern sectors often amount to less than the subsidies provided to them. In addition, Gordon and Li do not provide an explanation for the existence of other types of regulations and distortions in developing countries, such as distortions in factor markets and state ownership of large-scale modern enterprises.

Lin et al. (1995, 1996, 1999, 2003, 2009) propose an alternative explanation for the complicated regulations and distortions in developing countries. After World War II, a large number of colonial or semi-colonial countries won political independence. Compared with developed countries, these developing countries lagged far behind economically. It was high on every developing country government’s agenda to develop the economy as quickly as possible to achieve rapid economic take-off and eliminate poverty. At that time, national leaders and social elites in socialist and non-socialist developing countries shared a common belief in the development of

state-of-the-art technologies and industries as the best means of modernization. They aimed to catch up with and avoid exploitation by developed countries and to become economically and politically independent of developed countries. They therefore pursued the development of advanced heavy industries—the state-of-the-art industries at that time—and implemented development strategies that attempted to accelerate their development. However, advanced, capital-intensive industries were not consistent with the comparative advantages determined by their endowment structures—characterized either by labor abundance or resource abundance. Such a comparative advantage-defying (CAD) strategy¹ made enterprises in the government’s CAD industries non-viable in open, competitive markets.² Because of the CAD strategy, developing country governments were obliged to provide the non-viable firms with various subsidies and protection.

Theoretically, a developing country government could subsidize non-viable enterprises in the CAD industries by fiscal transfers with explicit taxes collected from other economic sectors. The required amount of taxation or subsidization would depend, however, on the size of the CAD industries: if they were small, subsidization through fiscal transfer would suffice.³ In reality, the capital level in the endowment structure of a developing country will be too small, the size of the CAD industries is often too large, and fiscal transfers alone will not be enough to compensate for the likely losses of the non-viable enterprises in the CAD industries. Facing this constraint, a government will have to make other institutional arrangements to implement this strategy.

One often-observed measure undertaken in a developing country is the distortion of factor prices—such as suppression of interest rates and over-valuation of domestic currencies—in order to reduce the costs of investment and imports of technology and equipment for non-viable enterprises. Such distortions result, however, in excess demand for those factors whose prices are suppressed. As a result, the government needs to use planned, administrative measures to guarantee allocation of those factors to the non-viable enterprises in the CAD industries (Lin, 2003, 2009).

When factor prices are distorted, the non-CAD industries—such as light industry and agriculture—will yield higher returns to the factors than the CAD industries and it will be profitable to reallocate resources from the CAD industries to other industries. If enterprises are owned and run by private agents, such arbitrage is likely. To avoid

¹ Similar to the definition in Rodrick (2005), the development strategy here refers to economic policies and institutional arrangements aimed at achieving the government’s development goals.

² As defined by Lin (2003), a normally managed firm is viable if it earns a socially acceptable expected profit without external subsidization or protection in a competitive market. According to Lin, the viability of a firm is determined by whether its choice of technology/product/industry is consistent with the specific characteristics of the economy’s endowment structure.

³ Agricultural subsidies in developed countries are an example of this case.

this, developing country governments often nationalize the enterprises in the CAD industries in order to strengthen their control over the use of resources.

The major hypothesis in this paper is that there is a positive relationship between the degree of economic distortions and the degree of deviation of the CAD strategy from the optimal industrial structure determined by the country's endowment structure. The larger the CAD industry, the more distortions will be needed—and loss of efficiency and social welfare will be greater.

Compared with former works, this paper makes two contributions: 1) it provides an alternative, consistent explanation for the existence of a series of distortions in developing countries; and 2) it shows how those distortions work together to achieve the developing country governments' goal of developing CAD industries. Lin and Zhang (2007) is a pioneering work modeling this idea; our paper is different in basic assumptions and in the emphasis on the interaction of various distortions.

In the next section, we set the economic environment of developing countries in which the government pursues a CAD strategy. Section 3 shows how economic distortions are combined to build an environment that supports the development of nonviable industry. Section 4 shows that institutional distortions are a function of the government's CAD strategy. Section 5 provides some other implications of the CAD strategy for institutional distortions. Section 6 concludes the paper with some remarks.

2. Baseline Model

2.1 Environment

Consider a small, open economy with three sectors: agriculture (Sector 1), light industry (Sector 2), and heavy industry (Sector 3). The production of each type of good requires inputs of both capital and labor. Total capital $K = K_1 + K_2 + K_3$, where K_1 is capital input in the agriculture, K_2 is capital input in light industry, and K_3 is capital input in heavy industry. Similarly, we have total labor $L = L_1 + L_2 + L_3$. Factors cannot flow internationally. We define the level of endowment structure in the economy by per capita capital, $k = K/L$. That is, the higher per capita capital, the higher the development structure in the economy. The goods prices $\{P_1^*, P_2^*, P_3^*\}$ are given by the international market.

The production functions are Cobb-Douglas functions:

$$Y_i = A_i K_i^{\alpha_i} L_i^{1-\alpha_i} \quad i = 1, 2, 3, \quad (1)$$

where $\alpha_1 < \alpha_2 < \alpha_3$, and A_i is the level of productivity in sector i in the economy. The key difference among these sectors is in capital intensity. The production of heavy industry is more capital intensive than that of light industry, and the production of light industry is more capital intensive than that of agriculture. The Cobb-Douglas form is adopted for simplicity.

The indirect utility function of the representative agent is

$$U^c(P^*, I) = I + \psi(P^*) \quad (2)$$

where $P^* = (P_1^*, P_2^*, P_3^*)$ is the price vector, and

$$I = \sum_{i=1}^3 P_i^* Y_i$$

is the total output value of the economy. $\psi(P^*)$ is non-increasing and strictly convex. This quasi-linear utility function form is adopted for simplicity.

On the policy side, there are activity-specific tax rate t , and subsidy rate s on production, which are constrained to be nonnegative. Let the set of protected sectors be denoted by S and unprotected sectors by T ⁴. The tax and subsidy make the producer prices deviate from P^* as follows:

$$P_i = \frac{1}{1+t} P_i^* \quad i \in T$$

and

$$P_j = \frac{1}{1-s} P_j^* \quad j \in S$$

There are no other fiscal instruments (in particular, no lump-sum non-distortional taxes).

In addition, for protected sectors, factor price regulation depresses factor prices from market-clearing levels by a rate of τ , and a corresponding directive allocation system directly mobilizes resources into protected sectors at lower prices.

These activities are financed by the government's tax revenue. The costs of these activities mainly consist of two parts: one arises from mobilizing resources into protected sectors and the other arises from supervising the utilization of resources in protected sectors. While factor prices are suppressed, it is profitable for a producer in a protected sector to take the opportunity of arbitrage by transferring resources to unprotected sectors, since these resources are directly allocated to them at prices lower than the market levels. So in addition to simply mobilizing resources, one of the most important functions of the directive allocation system is to prevent producers in protected sectors from taking this arbitrage opportunity. The government has to supervise the producers in protected sectors to make sure the resources directly allocated to them are used in protected sectors, and punish those who transfer resources.

The former part of the costs is increasing in the amount of resources to be allocated directly. The latter part of the costs is increasing in τ . The reason for this is that the larger τ is, the larger the incentive for arbitrage is, so the government has to increase the intensity of supervision as τ increases. Let $\bar{Y}_{j \in S}$ denote the output of protected

⁴ $T \cap S = \emptyset$, and $T \cup S = \{1, 2, 3\}$

sectors while the government does not intervene in the economy, that is, $t = s = \tau = 0$. Thus we characterize these costs as

$$m(\tau) \left(\sum_{j \in S} \frac{1}{1-s} P_j^* Y_j - \sum_{j \in S} P_j^* \bar{Y}_j \right)$$

where $m(\tau)$ measures the intensity of supervision, and

$$\sum_{j \in S} \frac{1}{1-s} P_j^* Y_j - \sum_{j \in S} P_j^* \bar{Y}_j$$

measures the amount of resources allocated directly by the difference between the size of protected sectors with distortions and those without distortions. $m(\cdot)$ is non-decreasing and strictly convex, satisfying the conditions that $m(0) = 0$, $m'(0) = 0$ and $m'(\infty) = \infty$.

The development strategy of the government is a sum of policies (t, s, τ, T, S) . Under its development strategy, the government's budget constraint is⁵

$$\sum_{i \in T} \frac{t}{1+t} P_i^* Y_i - \sum_{j \in S} \frac{s}{1-s} P_j^* Y_j - m(\tau) \left(\sum_{j \in S} \frac{1}{1-s} P_j^* Y_j - \sum_{j \in S} P_j^* \bar{Y}_j \right) = 0 \quad (3)$$

Instead of paying attention to the total output value of the economy, the government places a weight θ on the output value of sectors it favors and a weight $1 - \theta$ on the output value of the others, where θ is nonnegative, that is, $\theta \geq 0$. The government's objective function is in the following form⁶

$$U^g = \theta \ln \left(\sum_{j \in S} P_j^* Y_j \right) + (1 - \theta) \ln \left(\sum_{j \in T} P_j^* Y_j \right). \quad (4)$$

It is clear that the government's objective function U^g is a monotonic transformation of the consumer's utility function U^c if $T = \emptyset$ or $S = \emptyset$ with the implication that the government prefers none of these three sectors.

2.2 Economic Equilibrium without Distortions

We first characterize the economic equilibrium for a given set of policies (t, s, τ, T, S) . An *economic equilibrium* is defined as the wage rate and the interest rate (w, r) , and investment and employment levels for all sectors $(K_i, L_i)_{i=1,2,3}$, such that given (t, s, τ, T, S) and (w, r) , all producers choose their investment and employment optimally and the labor market and the capital market clear.

Each producer takes the wage and interest rate as given. Firms simply maximize net profits. Consequently, the optimization problem of each firm can be written as

$$\max_{K_i, L_i} \frac{1}{1+t} P_i^* A_i K_i^{\alpha_i} L_i^{1-\alpha_i} - w L_i - r K_i, \quad i \in T \text{ and}$$

⁵ We assume away usual items in the government's budget constraint such as a public expenditure, the cost of operating the tax system, etc., as they are not related to the CAD strategy. This simplification does no harm to our analysis.

⁶ This objective function is consistent with a more intuitive form

$$U^g = \theta \ln \left(\sum_{j \in S} P_j^* Y_j \right) + (1 - \theta) \ln (U^c(P^*, I)).$$

We adopt the current form for simplicity.

$$\max_{K_i, L_i} \frac{1}{1-s} P_j^* A_j K_j^{\alpha_j} L_j^{1-\alpha_j} - (1-\tau)wL_j - (1-\tau)rK_j. \quad j \in S$$

This maximization yields

$$K_i = \frac{\alpha_i}{1-\alpha_i} \frac{w}{r} L_i, \quad i = 1, 2, 3 \quad (5)$$

and

$$\pi_i = \frac{1}{1+t} P_i^* - AC_i = \frac{1}{1+t} P_i^* - \frac{w^{1-\alpha_i} r^{\alpha_i}}{\alpha_i (1-\alpha_i)^{1-\alpha_i} A_i}, \quad i \in T \quad (6)$$

$$\pi_j = \frac{1}{1-s} P_j^* - AC_j = \frac{1}{1-s} P_j^* - \frac{(1-\tau)w^{1-\alpha_j} r^{\alpha_j}}{\alpha_j (1-\alpha_j)^{1-\alpha_j} A_j}, \quad j \in S \quad (7)$$

where π denotes the profit from one unit of product and AC the average cost of production. Combining (5), (6), and (7) with the resource constraints

$$K = K_1 + K_2 + K_3 \quad (8)$$

and

$$L = L_1 + L_2 + L_3 \quad (9)$$

we can obtain the economic equilibrium. It is straightforward that without distortions, which sectors the economy specializes in depends on its endowment structure. As the capital level in the endowment structure increases, producers will enter relatively more capital-intensive sectors.

In order to exclude the trivial case where Sector 2 is dominated by a combination of Sector 1 and Sector 3, we assume that compared with A_1 and A_3 , A_2 is large enough to satisfy the condition

$$A_2 > \frac{(P_3^* A_3 \alpha_3^{\alpha_3} (1-\alpha_3)^{1-\alpha_3})^{\frac{\alpha_2-\alpha_1}{\alpha_3-\alpha_1}} (P_1^* A_1 \alpha_1^{\alpha_1} (1-\alpha_1)^{1-\alpha_1})^{\frac{\alpha_3-\alpha_2}{\alpha_3-\alpha_1}}}{P_2^* \alpha_2^{\alpha_2} (1-\alpha_2)^{1-\alpha_2}}. \quad (A1)$$

We therefore have (proof in the appendix):

Proposition 1:

Suppose assumption (A1) and the conditions $t = s = \tau = 0$, $T = \{1, 2\}$ and $S = \{3\}$ hold. The economic equilibrium is as follows:

if $k \leq \left[\frac{P_2^* A_2}{P_1^* A_1} \left(\frac{\alpha_2(1-\alpha_1)}{\alpha_1(1-\alpha_2)} \right)^{\alpha_2} \frac{1-\alpha_2}{1-\alpha_1} \right]^{\frac{1}{\alpha_1-\alpha_2}}$, then $Y_1 > 0, Y_2 = Y_3 = 0$;

if $\left[\frac{P_2^* A_2}{P_1^* A_1} \left(\frac{\alpha_2(1-\alpha_1)}{\alpha_1(1-\alpha_2)} \right)^{\alpha_2} \frac{1-\alpha_2}{1-\alpha_1} \right]^{\frac{1}{\alpha_1-\alpha_2}} < k < \left[\frac{P_2^* A_2}{P_1^* A_1} \left(\frac{\alpha_2(1-\alpha_1)}{\alpha_1(1-\alpha_2)} \right)^{\alpha_1} \frac{1-\alpha_2}{1-\alpha_1} \right]^{\frac{1}{\alpha_1-\alpha_2}}$,
then $Y_1 > 0, Y_2 > 0, Y_3 = 0$;

if $\left[\frac{P_2^* A_2}{P_1^* A_1} \left(\frac{\alpha_2(1-\alpha_1)}{\alpha_1(1-\alpha_2)} \right)^{\alpha_1} \frac{1-\alpha_2}{1-\alpha_1} \right]^{\frac{1}{\alpha_1-\alpha_2}} \leq k \leq \left[\frac{P_3^* A_3}{P_2^* A_2} \left(\frac{\alpha_3(1-\alpha_2)}{\alpha_2(1-\alpha_3)} \right)^{\alpha_3} \frac{1-\alpha_3}{1-\alpha_2} \right]^{\frac{1}{\alpha_2-\alpha_3}}$,
then $Y_2 > 0, Y_1 = Y_3 = 0$;

if $\left[\frac{P_3^* A_3}{P_2^* A_2} \left(\frac{\alpha_3(1-\alpha_2)}{\alpha_2(1-\alpha_3)} \right)^{\alpha_3} \frac{1-\alpha_3}{1-\alpha_2} \right]^{\frac{1}{\alpha_2-\alpha_3}} < k < \left[\frac{P_3^* A_3}{P_2^* A_2} \left(\frac{\alpha_3(1-\alpha_2)}{\alpha_2(1-\alpha_3)} \right)^{\alpha_2} \frac{1-\alpha_3}{1-\alpha_2} \right]^{\frac{1}{\alpha_2-\alpha_3}}$,
then $Y_2 > 0, Y_3 > 0, Y_1 = 0$;

if $k \geq \left[\frac{P_3^* A_3}{P_2^* A_2} \left(\frac{\alpha_3(1-\alpha_2)}{\alpha_2(1-\alpha_3)} \right)^{\alpha_2} \frac{1-\alpha_3}{1-\alpha_2} \right]^{\frac{1}{\alpha_2-\alpha_3}}$, then $Y_3 > 0, Y_1 = Y_2 = 0$.

Note that the above economic equilibrium also maximizes the social welfare function $V(P^*, I)$.

3. Economic Equilibrium under CAD Strategy

In this section, we begin to discuss how governments in developing countries make use of economic distortions to implement a CAD strategy. We show how the government changes the economic environment so that CAD industries can survive, and calculate the resulting economic equilibrium under CAD strategy.

We characterize the situation of developing countries as Case 2, where agriculture and light industry produce, and heavy industry does not produce. Therefore we also assume that

$$\left[\frac{P_2^* A_2}{P_1^* A_1} \left(\frac{\alpha_2(1-\alpha_1)}{\alpha_1(1-\alpha_2)} \right)^{\alpha_2} \frac{1-\alpha_2}{1-\alpha_1} \right]^{\frac{1}{\alpha_1-\alpha_2}} < k < \left[\frac{P_2^* A_2}{P_1^* A_1} \left(\frac{\alpha_2(1-\alpha_1)}{\alpha_1(1-\alpha_2)} \right)^{\alpha_1} \frac{1-\alpha_2}{1-\alpha_1} \right]^{\frac{1}{\alpha_1-\alpha_2}}. (A2)$$

Consider a government pursuing a CAD strategy that supports heavy industry, the CAD industry, both by lowering its factor prices and by taxing agriculture and light industry. It immediately follows that $\theta > 0$, $T = \{1, 2\}$, and $S = \{3\}$, and that the CAD strategy becomes $(t, s, \tau, \{1, 2\}, \{3\})$ and the government's policy set boils down to (t, s, τ) .

As shown in Proposition 1, without distortions only Sector 1 and Sector 2 are invested. The factor prices (w, r) are solutions to the following set of equations

$$\begin{aligned} \pi_1 &= P_1^* - \frac{w^{1-\alpha_1} r^{\alpha_1}}{\alpha^{\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1} = 0 \\ \pi_2 &= P_2^* - \frac{w^{1-\alpha_2} r^{\alpha_2}}{\alpha_2^{\alpha_2} (1-\alpha_2)^{1-\alpha_2} A_2} = 0 \end{aligned}$$

which are

$$w = \frac{[P_1^* \alpha_1^{\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1]^{\frac{\alpha_2}{\alpha_2-\alpha_1}}}{[P_2^* \alpha_2^{\alpha_2} (1-\alpha_2)^{1-\alpha_2} A_2]^{\frac{\alpha_1}{\alpha_2-\alpha_1}}},$$

and

$$r = \frac{[P_1^* \alpha_1^{\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1]^{\frac{\alpha_2-1}{\alpha_2-\alpha_1}}}{[P_2^* \alpha_2^{\alpha_2} (1-\alpha_2)^{1-\alpha_2} A_2]^{\frac{\alpha_1-1}{\alpha_2-\alpha_1}}}.$$

Using the above factor prices, we find immediately that

$$\begin{aligned} \pi_3 &= P_3^* - \frac{w^{1-\alpha_3} r^{\alpha_3}}{\alpha_3^{\alpha_3} (1-\alpha_3)^{1-\alpha_3} A_3} \\ &= P_3^* (1 - V) < 0, \end{aligned}$$

where

$$V \equiv \left[\frac{P_2^* \alpha_2^{\alpha_2} (1-\alpha_2)^{1-\alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1} \right]^{\frac{\alpha_3-\alpha_1}{\alpha_2-\alpha_1}} \frac{P_1^* \alpha_1^{\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1}{P_3^* \alpha_3^{\alpha_3} (1-\alpha_3)^{1-\alpha_3} A_3},$$

measuring the non-viability of firms in Sector 3 in such an economic environment⁷. The larger V is, the more difficult it is for Sector 3 to survive. Thus it also represents the difficulty for the government in supporting Sector 3.

Since when $\theta \neq 0$ the government pays special attention to the size of Sector 3, it is desirable for the government to set up an economic environment in which heavy industry will survive⁸. In this paper we focus on those economic environments in which each of the three sectors is invested⁹.

Given (w, r) , according to (7) the policy set (t, s, τ) has to satisfy the conditions

$$\begin{aligned}\pi_1 &= \frac{1}{1+t} P_1^* - \frac{w^{1-\alpha_1} r^{\alpha_1}}{\alpha_1^{1-\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1} = 0 \\ \pi_2 &= \frac{1}{1+t} P_2^* - \frac{w^{1-\alpha_2} r^{\alpha_2}}{\alpha_2^{1-\alpha_2} (1-\alpha_2)^{1-\alpha_2} A_2} = 0 \\ \pi_3 &= \frac{1}{1-s} P_3^* - \frac{(1-\tau) w^{1-\alpha_3} r^{\alpha_3}}{\alpha_3^{1-\alpha_3} (1-\alpha_3)^{1-\alpha_3} A_3} = 0.\end{aligned}$$

It immediately follows that

$$w = \frac{1}{1+t} \frac{[P_1^* \alpha_1^{\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1]^{\frac{\alpha_2}{\alpha_2-\alpha_1}}}{[P_2^* \alpha_2^{\alpha_2} (1-\alpha_2)^{1-\alpha_2} A_2]^{\frac{\alpha_1}{\alpha_2-\alpha_1}}} \quad (10)$$

and

$$r = \frac{1}{1+t} \frac{[P_1^* \alpha_1^{\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1]^{\frac{\alpha_2-1}{\alpha_2-\alpha_1}}}{[P_2^* \alpha_2^{\alpha_2} (1-\alpha_2)^{1-\alpha_2} A_2]^{\frac{\alpha_1-1}{\alpha_2-\alpha_1}}} \quad (11)$$

and

$$\begin{aligned}\pi_3 &= \frac{1}{1-s} P_3^* - \frac{(1-\tau) w^{1-\alpha_3} r^{\alpha_3}}{\alpha_3^{1-\alpha_3} (1-\alpha_3)^{1-\alpha_3} A_3} \\ &= \frac{1}{1-s} P_3^* \left[1 - \frac{(1-s)(1-\tau)}{1+t} V \right] = 0.\end{aligned} \quad (12)$$

Inspection of (10), (11), and (12) reveals that each of these three policy instruments contributes to build an economic environment favorable to production in Sector 3. While subsidization increases the producer price of Sector 3, both taxation and factor price regulation reduce its factor prices.

In addition, If polices (t, s, τ) are large enough to satisfy the condition

$$\frac{(1-s)(1-\tau)}{1+t} = \frac{1}{V}, \text{ (SC)}$$

then firms in Sector 3 get the same zero profit as those in Sector 1 and Sector 2. Thus condition (SC) is a necessary condition for an economic environment in which firms in Sector 3 can survive. Summarizing the analysis (proof in the text):

⁷ By assumption (A1) it is straightforward to verify $V > 1$.

⁸ A firm survives if it can earn acceptable profits as other firms in the economy. A nonviable firm can survive with government subsidies.

⁹ Although other economic environments are theoretically possible, in practice almost no developing country governments have pursued the CAD strategy to the extent that agriculture, industry, or light industry is not invested. In addition, this simplification does no harm to our analysis of the mechanism of institutional distortions.

Lemma 1:

Suppose assumption (A1) holds. Then each of the three sectors gets zero profit, if policies (t, s, τ) satisfy condition (SC).

We proceed to characterize the economic equilibrium under the environment in which the set of policies (t, s, τ) satisfies condition (SC). Substituting (5) into (8), we obtain

$$\frac{\alpha_1}{1-\alpha_1} L_1 + \frac{\alpha_2}{1-\alpha_2} L_2 + \frac{\alpha_3}{1-\alpha_3} L_3 = K \frac{r}{w}.$$

Combining the above expression with (9), (10), and (11), equilibrium labor allocations are obtained as follows:

$$\left(\frac{\alpha_2}{1-\alpha_2} - \frac{\alpha_1}{1-\alpha_1} \right) L_2 + \left(\frac{\alpha_3}{1-\alpha_3} - \frac{\alpha_1}{1-\alpha_1} \right) L_3 = K \left[\frac{P_2^* \alpha_2^2 (1-\alpha_2)^{1-\alpha_2} A_2}{P_1^* \alpha_1^{1-\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1} \right]^{\frac{1}{\alpha_2-\alpha_1}} - \frac{\alpha_1}{1-\alpha_1} L. \quad (13)$$

By assumption (A2), the right side of this expression is positive, which ensures nonnegative solutions for L_2 and L_3 . We therefore have (proof in the text):

Lemma 2:

Suppose assumptions (A1) and (A2) and condition (SC) hold, then in equilibrium (10) and (11) hold, and

$$L_1 = \frac{1-\alpha_1}{\alpha_2-\alpha_1} \left\{ \alpha_2 L - (1-\alpha_2) K \left[\frac{P_2^* \alpha_2^2 (1-\alpha_2)^{1-\alpha_2} A_2}{P_1^* \alpha_1^{1-\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1} \right]^{\frac{1}{\alpha_2-\alpha_1}} + \frac{\alpha_3-\alpha_2}{1-\alpha_3} L_3 \right\}, \quad (14)$$

$$L_2 = \frac{1-\alpha_2}{\alpha_2-\alpha_1} \left\{ (1-\alpha_1) K \left[\frac{P_2^* \alpha_2^2 (1-\alpha_2)^{1-\alpha_2} A_2}{P_1^* \alpha_1^{1-\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1} \right]^{\frac{1}{\alpha_2-\alpha_1}} - \alpha_1 L - \frac{\alpha_3-\alpha_1}{1-\alpha_3} L_3 \right\}, \quad (15)$$

$$L_3 < \hat{L}_3 \equiv \frac{1-\alpha_3}{\alpha_3-\alpha_1} \left\{ (1-\alpha_1) K \left[\frac{P_2^* \alpha_2^2 (1-\alpha_2)^{1-\alpha_2} A_2}{P_1^* \alpha_1^{1-\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1} \right]^{\frac{1}{\alpha_2-\alpha_1}} - \alpha_1 L \right\}. \quad (16)$$

The first observation is that the equilibrium is indeterminate, for in equilibrium there are three sectors producing but only two factors in the economy. Moreover, L_1 is increasing in L_3 while L_2 is decreasing in L_3 . This reflects the fact that, in terms of employment, Sector 1 and Sector 3 are complementary while Sector 2 and Sector 3 are substitutes.

However, as the government's policies are financed by the taxes collected from Sector 1 and Sector 2, not all the equilibrium value of L_3 in the interval $(0, \hat{L}_3)$ is available for the government. In order to find the size of Sector 3 that can be supported by the government's budget constraint, we take the government's budget constraint into account. Under the CAD strategy $(t, s, \tau, \{1, 2\}, \{3\})$ the government's budget constraint (3) can be rewritten as

$$\frac{t}{1+t} (P_1^* Y_1 + P_2^* Y_2) - \frac{s}{1-s} P_3^* Y_3 - \frac{1}{1-s} m(\tau) P_3^* Y_3 = 0.$$

where we take into account $\bar{Y}_3 = 0$.

Simplifying the above expression by (9) and the properties of the Cobb-Douglas

production function, we have

$$\frac{tL}{1-\alpha_1} + tL_2 \left(\frac{1}{1-\alpha_2} - \frac{1}{1-\alpha_1} \right) = \frac{tL_3}{1-\alpha_1} + (s + m(\tau)) \frac{L_3}{1-\alpha_3}. \quad (17)$$

The above expression shows that the government's budget constraint implies a positive relationship between L_2 and L_3 . Intuitively, as the size of Sector 3 increases, the government needs more tax revenue to finance both the subsidy and the directive allocation system for Sector 3. As a result, the size of Sector 2 has to increase to enlarge the resources that can be taxed.

By (13) and (17), the level of employment in Sector 3 that can be supported by the government's budget constraint can be expressed as a function of the set of policies (t, s, τ)

$$L_3 = \frac{(1-\alpha_3) \left(K \left[\frac{P_2^* \alpha_2^{\alpha_2} (1-\alpha_2)^{1-\alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1} \right]^{\frac{1}{\alpha_2-\alpha_1}} + L \right) t}{s+m(\tau)+t}. \quad (18)$$

By substituting condition (SC) into (18) to eliminate s , L_3 is reduced to be a function of t and τ

$$L_3 = (1-\alpha_3) \left(K \left[\frac{P_2^* \alpha_2^{\alpha_2} (1-\alpha_2)^{1-\alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1} \right]^{\frac{1}{\alpha_2-\alpha_1}} + L \right) \frac{t}{(1+t)(1-\frac{1}{V(1-\tau)})+m(\tau)}. \quad (19)$$

The first interesting feature is that L_3^s is increasing in t . Intuitively, taxation contributes to the development of Sector 3 in two ways: first, it suppresses the factor price rate, and second, it increases tax revenue. Moreover, τ affects L_3 in two opposite ways: first, it increases L_3 by suppressing the factor price from its market-clearing level, and second, it decreases L_3 by increasing the government's expenditure through $m(\tau)$. This discussion is summarized in the following proposition (proof in the text).

Proposition 2:

Suppose assumptions (A1) and (A2) and condition (SC) hold. Then the economic equilibrium supported by the government's budget constraint (3) is given by (14), (15), (16), and (19).

4. Institutional Distortions under CAD Strategy

In this section, we show how institutional distortions are combined to implement a CAD strategy as described in the above section. To illustrate the mechanism in the simplest possible way, we will focus on a subset of the parameter space and abstract from other interactions. Throughout, we assume that there is an upper bound on taxation, so that $t < \bar{t}$. This limit can be institutional, or it may arise because of the ability of producers to hide their output or shift into informal production¹⁰.

¹⁰ In reality, there are many limits that impose an upper limit on taxation because high taxation rates might not lead to high taxation revenue. First, as the taxation rate rises, it is more difficult to collect taxes and the costs of tax collection increase. Second, the tax base will become smaller as the taxation rate rises. This is due to the fact that, on the one hand, taxation will decrease the returns to factors and

The timing of the events is as follows: first, policies are set; then, investments are made. An *institutional equilibrium* is defined as a set of policies (t, s, τ) that satisfies (3) and maximizes the government's objective function, taking the economic equilibrium as a function of the set of policies as given.

While $\theta > 0$, $T = \{1, 2\}$, and $S = \{3\}$, according to (4) the government's objective function can be written as

$$U^g = \theta \ln P_3^* Y_3 + (1 - \theta) \ln \left(\sum_{i=1}^2 P_i^* Y_i \right). \quad (20)$$

By combining (1), (5), (10), (11), (14), and (15), it can be shown that

$$P_1^* Y_1 + P_2^* Y_2 = P_1^* A_1 \alpha_1^{\alpha_1} (1 - \alpha_1)^{1 - \alpha_1} \left[\frac{P_2^* \alpha_2^{\alpha_2} (1 - \alpha_2)^{1 - \alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1 - \alpha_1)^{1 - \alpha_1} A_1} \right]^{\frac{\alpha_1}{\alpha_1 - \alpha_2}} \cdot \left\{ K \left[\frac{P_2^* \alpha_2^{\alpha_2} (1 - \alpha_2)^{1 - \alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1 - \alpha_1)^{1 - \alpha_1} A_1} \right]^{\frac{1}{\alpha_2 - \alpha_1}} + L - \frac{L_3}{1 - \alpha_3} \right\} \quad (21)$$

$$P_3^* Y_3 = P_3^* A_3 \left(\frac{\alpha_3}{1 - \alpha_3} \right)^{\alpha_3} \left[\frac{P_2^* \alpha_2^{\alpha_2} (1 - \alpha_2)^{1 - \alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1 - \alpha_1)^{1 - \alpha_1} A_1} \right]^{\frac{\alpha_3}{\alpha_1 - \alpha_2}} L_3, \quad (22)$$

where the total output value of Sector 1 and Sector 2 is decreasing in L_3 , while the output value of Sector 3 is increasing in L_3 . Based on this tradeoff, the government's target employment in Sector 3 is calculated as

$$L_3^d \in \operatorname{argmax} U^g = \theta \ln P_3^* Y_3 + (1 - \theta) \ln (P_1^* Y_1 + P_2^* Y_2)$$

with (21) and (22). The first-order condition for an interior solution can be expressed as

$$\theta \frac{1}{L_3^d} - (1 - \theta) \frac{1}{(1 - \alpha_3) \left(K \left[\frac{P_2^* \alpha_2^{\alpha_2} (1 - \alpha_2)^{1 - \alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1 - \alpha_1)^{1 - \alpha_1} A_1} \right]^{\frac{1}{\alpha_2 - \alpha_1}} + L \right) - L_3^d} = 0,$$

and we immediately obtain

$$L_3^d = \theta \left(K \left[\frac{P_2^* \alpha_2^{\alpha_2} (1 - \alpha_2)^{1 - \alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1 - \alpha_1)^{1 - \alpha_1} A_1} \right]^{\frac{1}{\alpha_2 - \alpha_1}} + L \right) (1 - \alpha_3). \quad (23)$$

As expected, the employment in Sector 3 demanded by the government L_3^d is increasing in θ , which is the weight placed on the output value of Sector 3.

Before we characterize the institutional equilibrium, it is useful to calculate the maximum L_3 that can be supported by policy. Maximization of (19) gives the optimal choice (t^*, s^*, τ^*) ¹¹ and the maximum L_3^* . It is straightforward to see that since L_3 is increasing in t , the tax rate will be set as high as possible, so $t^* = \bar{t}$.

decrease the efforts of workers and capacity utilization; and, on the other hand, taxation could push resources out of the formal economy and underground because of the weakness of institutions in developing countries.

¹¹ In fact, only t^* and τ^* are determined by this maximization. Given (t^*, τ^*) , s^* is obtained by condition (SC) as

$$s^* = 1 - \frac{1 + t^*}{V(1 - \tau^*)}.$$

Consequently τ^* satisfies the first-order condition¹²

$$\frac{\partial L_3}{\partial \tau} = \frac{(1-\alpha_3) \left(K \left[\frac{P_2^* \alpha_2^{\alpha_2} (1-\alpha_2)^{1-\alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1} \right]^{\frac{1}{\alpha_2-\alpha_1}} + L \right) \bar{t}}{\left[(1+\bar{t})(1-\frac{1}{V(1-\tau^*)}) + m(\tau^*) \right]^2} \left[\frac{1+\bar{t}}{V(1-\tau^*)^2} - m'(\tau^*) \right] = 0, \quad (24)$$

and we have¹³

$$L_3^* = \frac{(1-\alpha_3) \left(K \left[\frac{P_2^* \alpha_2^{\alpha_2} (1-\alpha_2)^{1-\alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1} \right]^{\frac{1}{\alpha_2-\alpha_1}} + L \right) \bar{t}}{(1+\bar{t})(1-\frac{1}{V(1-\tau^*)}) + m(\tau^*)}.$$

Based on (19), (23), and condition (SC), the institutional equilibrium is determined. We start with a simple case where factor price regulation is not necessary for implementing CAD strategy; that is, we have $\tau = 0$ in equilibrium. Note that while $t = \bar{t}$ and $\tau = 0$, by (19)

$$L_3 = (1-\alpha_3) \left(K \left[\frac{P_2^* \alpha_2^{\alpha_2} (1-\alpha_2)^{1-\alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1} \right]^{\frac{1}{\alpha_2-\alpha_1}} + L \right) \frac{\bar{t}}{(1+\bar{t})(1-\frac{1}{V})}.$$

Then combining the above expression with (23), we immediately have that

$$L_3^d \leq (1-\alpha_3) \left(K \left[\frac{P_2^* \alpha_2^{\alpha_2} (1-\alpha_2)^{1-\alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1} \right]^{\frac{1}{\alpha_2-\alpha_1}} + L \right) \frac{\bar{t}}{(1+\bar{t})(1-\frac{1}{V})},$$

if and only if

$$\theta \leq \frac{\bar{t}}{(1+\bar{t})(1-\frac{1}{V})}.$$

Observing the above inequality, we know that it holds while θ or V is relatively small but \bar{t} is relatively large. Intuitively, compared with its taxation capacity, if the government places less weight on its CAD strategy, or if the viability of the supported sector is not very weak, then taxation and subsidization will be enough to implement its CAD strategy and there is no need for factor price regulation and the corresponding directive allocation system.

Setting (18) equal to (23), we have

$$\theta = \frac{t}{s+m(\tau)+t}.$$

Combined with condition (SC), the above expression gives the following institutional equilibrium (t, s, τ)

¹² Here we assume that $m(\tau)$ is so convex that for $\tau^* \in [0, 1]$,

$$\frac{2(1+\bar{t})}{V(1-\tau^*)^3} < m''(\tau^*),$$

then we have

$$\begin{aligned} \frac{\partial^2 L_3}{\partial \tau^2} &= \frac{2(1-\alpha_3) \left(K \left[\frac{P_2^* \alpha_2^{\alpha_2} (1-\alpha_2)^{1-\alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1} \right]^{\frac{1}{\alpha_2-\alpha_1}} + L \right) \bar{t}}{\left[(1+\bar{t})(1-\frac{1}{V(1-\tau^*)}) + m(\tau^*) \right]^3} \left[m'(\tau^*) - \frac{1+\bar{t}}{V(1-\tau^*)^2} \right]^2 \\ &+ \frac{(1-\alpha_3) \left(K \left[\frac{P_2^* \alpha_2^{\alpha_2} (1-\alpha_2)^{1-\alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1} \right]^{\frac{1}{\alpha_2-\alpha_1}} + L \right) \bar{t}}{\left[(1+\bar{t})(1-\frac{1}{V(1-\tau^*)}) + m(\tau^*) \right]^2} \left[\frac{2(1+\bar{t})}{V(1-\tau^*)^3} - m''(\tau^*) \right] < 0 \end{aligned}$$

¹³ In this paper we focus on the case where the largest size of Sector 3 that can be supported by policies does not reach the upper bound, that is $L_3^* < \hat{L}_3$. This implies that \bar{t} should be small enough to satisfy the following condition

$$\bar{t} < \frac{\hat{L}_3[1+m(\tau^*)-\frac{1}{V(1-\tau^*)}]}{\hat{L}_3[\frac{1}{V(1-\tau^*)}-1]+(1-\alpha_3) \left(K \left[\frac{P_2^* \alpha_2^{\alpha_2} (1-\alpha_2)^{1-\alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1} \right]^{\frac{1}{\alpha_2-\alpha_1}} + L \right)} < V-1.$$

$$t = \frac{\theta[V(1-\tau)-1]-\theta V(1-\tau)m(\tau)}{\theta+(1-\theta)V(1-\tau)},$$

$$s = \frac{(1-\theta)[V(1-\tau)-1]-\theta m(\tau)}{\theta+(1-\theta)V(1-\tau)},$$

and

$$0 \leq \tau \leq \min\{1, \bar{\tau}\},$$

where the upper bound $\bar{\tau}$ is set in order to make (t, s) reasonable, that is $0 \leq t \leq \bar{t}$ and $0 \leq s \leq 1$ ¹⁴.

Although in equilibrium a spectrum of policy sets are all theoretically optimal, the policy set with $\tau = 0$ is of the greatest practical significance. The reason is that it allows the CAD strategy to be implemented totally by the already existing tax system, without introducing other institutions into the economy. The above discussion is summarized in the following proposition (proof in the text):

Proposition 3:

Suppose assumptions (A1) and (A2) and condition (SC) hold. Then when

$$\theta \leq \frac{\bar{t}}{(1+\bar{t})(1-\frac{1}{V})},$$

factor price regulation and the corresponding directive allocation system are not necessary for implementing CAD strategy, and there exists an institutional equilibrium in which

$$\tau = 0,$$

and

$$t = \frac{\theta(V-1)}{(1-\theta)V+\theta},$$

and

$$s = \frac{(1-\theta)(V-1)}{(1-\theta)V+\theta}.$$

It is interesting to make some comparative static analysis. In this case, we find that as θ increases, t increases but s decreases. An increase in t results in an increase in tax revenue, which, combined with the decrease in s , enables the government to subsidize more production in Sector 3. Moreover, as expected, both t and s are increasing in V , which reflects the fact that Sector 3, with higher production cost, requires more protection both from taxation and subsidization.

By contrast, when θ or V is so large or \bar{t} is so small that it satisfies condition

¹⁴ By (25), condition $0 \leq t \leq \bar{t}$ requires

$$\frac{1}{V(1-\tau)} - 1 \leq m(\tau) \leq (1+\bar{t}) \left(\frac{1}{V(1-\tau)} - 1 \right) + \frac{\bar{t}}{\theta}. (*)$$

We assume that $m(\tau)$ is convex enough to ensure that there exists such a τ_1 that $(*)$ holds for $\tau \in [0, \tau_1]$. By (25), condition $0 \leq s \leq 1$ requires

$$m(\tau) \leq \frac{1-\theta}{\theta} [V(1-\tau) - 1]. (**)$$

Let τ_2 denote the value of τ which makes $(**)$ equal. Then $(**)$ holds for $\tau \in [0, \tau_2]$. Thus we have $\bar{\tau} = \min\{\tau_1, \tau_2\}$.

$$\theta > \frac{\bar{t}}{(1+\bar{t})(1-\frac{1}{V(1-\tau^*)})+m(\tau^*)},$$

we have $L_3^d > L_3^*$. Consequently, all the policies will be used to the extent that they maximize L_3 , that is, the institutional equilibrium is $(\bar{t}, 1 - \frac{1+\bar{t}}{V(1-\tau^*)}, \tau^*)$.

According to (24), we have

$$\frac{\partial \tau^*}{\partial (\frac{1+\bar{t}}{V})} = \frac{-(1-\tau^*)^{-2}}{2\frac{1+\bar{t}}{V(1-\tau^*)^3} - m''(\tau^*)} > 0.$$

The above expression shows that if the capacity for taxation is large relative to the difficulty in supporting Sector 3, then factor price regulation is more intensive. The reason for this is straightforward. As by condition (SC),

$$\left| \frac{\partial^2 s}{\partial \tau \partial (\frac{1+\bar{t}}{V})} \right| = \frac{1}{(1-\tau)^2} > 0,$$

that is, τ becomes a better substitute for s in satisfying condition (SC) when $(1+\bar{t})/V$ increases, then more revenue will be spent on factor price regulation rather than subsidization. This result is consistent with the “resource curse.” In those countries with more resources to be taxed, the governments tend to impose more intensive factor price regulation on the economy to implement their CAD strategy. The result is worse economic performance (Lin 2009).

To complete the analysis, we at last consider the case where

$$\frac{\bar{t}}{(1+\bar{t})(1-\frac{1}{V})} < \theta \leq \frac{\bar{t}}{(1+\bar{t})(1-\frac{1}{V(1-\tau^*)})+m(\tau^*)}.$$

In this case, by (19) and (23) we have

$$\frac{(1-\alpha_3) \left(K \left[\frac{P_2^* \alpha_2^{\alpha_2} (1-\alpha_2)^{1-\alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1} \right]^{\frac{1}{\alpha_2-\alpha_1}} + L \right) \bar{t}}{(1+\bar{t})(1-\frac{1}{V})} < L_3^d \leq L_3^*.$$

Therefore we have an institutional equilibrium where $t = \bar{t}$ and $\tau \leq \tau^*$ satisfying the condition

$$\theta = \frac{\bar{t}}{(1+\bar{t})(1-\frac{1}{V(1-\tau)})+m(\tau)}.$$

In equilibrium, we have

$$\frac{\partial \tau}{\partial \theta} = -\frac{\theta^{-2} \bar{t}}{m'(\tau) - \frac{1+\bar{t}}{V(1-\tau)^2}} > 0,$$

and

$$\frac{\partial \tau}{\partial \bar{t}} = \frac{\theta^{-1} - 1}{m'(\tau) - \frac{1+\bar{t}}{V(1-\tau)^2} - \frac{1}{V(1-\tau)}} < 0.$$

We summarize the above discussion in the following proposition:

Proposition 4:

Suppose assumptions (A1) and (A2) and condition (SC) hold. Then when

$$\theta > \frac{\bar{t}}{(1+\bar{t})(1-\frac{1}{V})},$$

factor price regulation and the corresponding directive allocation system are necessary for implementing CAD strategy. In equilibrium,

$$\frac{\partial \tau}{\partial \theta} \geq 0,$$

and

$$\frac{\partial \tau}{\partial \bar{t}} \begin{cases} < 0 & : \quad \theta \leq \frac{\bar{t}}{(1+\bar{t})(1-\frac{1}{V(1-\tau^*)})+m(\tau^*)} \\ > 0 & : \quad \theta > \frac{\bar{t}}{(1+\bar{t})(1-\frac{1}{V(1-\tau^*)})+m(\tau^*)}. \end{cases}$$

Figure 1 shows the relationship between institutional distortions and the CAD strategy described in Proposition 3 and Proposition 4. In the first area we depict the problem of government. U_1 , U_2 and U_3 , based on the government's objective function (20), are indifference curves. These indifference curves are different in θ , and we have $\theta_3 > \theta_2 > \theta_1$. The curve B , based on (21) and (22), represents the economy's feasible set, which is a trade-off between $P_1^*Y_1 + P_2^*Y_2$ and $P_3^*Y_3$. We depict t in the second area and τ in the fourth area. As shown in the figure, $P_3^*Y_3$ is increasing in t and τ , and gets its largest value when $t = \bar{t}$ and $\tau = \tau^*$.

Economic equilibrium is the point at which the indifference curves are tangential to the feasible set, while the institutional equilibrium is given by the points on the curves t and τ corresponding to the points of economic equilibrium on curve B . As θ becomes larger, the indifference curve moves upward, resulting in a larger size of Sector 3 and a larger t or τ . While $P_3^*Y_3$ is small, only taxation is employed, that is, $t > 0$ and $\tau = 0$. If $P_3^*Y_3$ is so large that t reaches \bar{t} , then factor price regulation will be introduced, that is, $\tau > 0$.

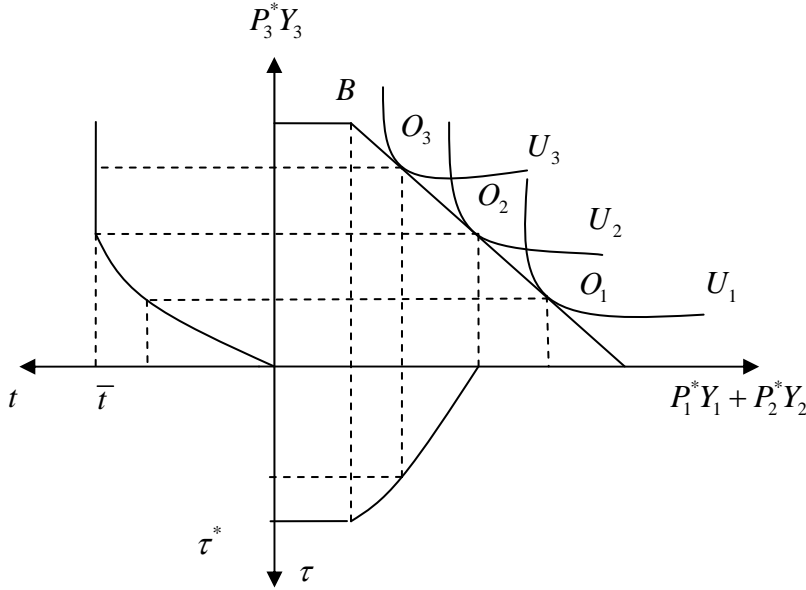


Figure 1: Institutional Distortions and CAD Strategy

5. Implications for Other Distortions

Many other institutional distortions make sense once the government's CAD strategy is taken into account. It has been widely recognized that enterprises in developing countries suffer from poor performance because of poor management. However it is common in developing countries to find, mostly in capital-intensive industries, such distortions as government ownership, direct government operation, investment licensing, etc. These distortions share the feature that the government to some extent deprives the enterprises of autonomy in production.

Without autonomy in production, producers have less incentive to improve firm performance. The result will be lower productivity in Sector 3 if the producers are deprived of autonomy in production. Let A_3^g denote the productivity of Sector 3, and V^g denote the non-viability of Sector 3, when its producers are deprived of autonomy in production. Then we have

$$A_3^g < A_3, \quad V^g > V$$

and condition (SC) changes into

$$\frac{(1-s)(1-\tau)}{1+t} = \frac{1}{V^g}.$$

That is, Sector 3 becomes more non-viable with deprivation of autonomy, and more institutional distortions are required for firms in Sector 3 to survive. In this way, even in terms of the CAD strategy, it is not useful for the government to deprive the producers in Sector 3 of production autonomy.

However, the other side of the coin is optimistic. As shown in Section 2, in order to make sure the resources directly allocated are used in Sector 3, the government has to supervise the producers in Sector 3 and punish those who transfer resources. The costs involved supervision account for a considerable part of the government's expenditure in running the directive allocation system.

By depriving the producers in Sector 3 of autonomy in production, for example by nationalizing firms in Sector 3, the government is able to change the objective of producers in Sector 3. As members of government, producers in Sector 3 will take into account the benefits of the CAD strategy for the government, instead of simply maximizing the net profit of production. As a result, they will have less incentive to arbitrage, and the government can reduce expenditure by lowering the intensity of supervision $m(\tau)$. Let $m^g(\tau)$ denote the intensity of supervision while producers in Sector 3 are deprived of autonomy in production. Then we have

$$m^g(\tau) < m(\tau).$$

As shown above, while $L_3^d > L_3^*$ it is desirable for the government to introduce other policies to increase the size of Sector 3. If the government deprives the producers in Sector 3 of autonomy in production, then according to (19) employment in Sector 3

becomes

$$L_3 = \frac{(1-\alpha_3) \left(K \left[\frac{P_2^* \alpha_2^2 (1-\alpha_2)^{1-\alpha_2} A_2}{P_1^* \alpha_1^2 (1-\alpha_1)^{1-\alpha_1} A_1} \right]^{\frac{1}{\alpha_2-\alpha_1}} + L \right) t}{(1+t)(1-\frac{1}{Vg(1-\tau)}) + m^g(\tau)}. \quad (25)$$

Comparing the above expression and (19), we find that depriving producers of autonomy has two effects on the size of Sector 3. The former is the negative effect through A_3 and then V ; the latter is the positive effect through $m(\tau)$. When the negative effect dominates, which means that deprivation of the producers' autonomy in production has more negative effect on productivity than positive effect on supervision costs, it is undesirable for the government to nationalize the enterprises in Sector 3 and deprive the producers' autonomies in production. On the contrary, if the positive effect dominates, it is desirable for the government to nationalize the enterprises in this sector.

Let τ^g denote the optimal choice of τ by the government and L_3^g denote the maximum L_3 while the enterprises in Sector 3 are nationalized. By (25) we have

$$\frac{\partial L_3}{\partial \tau} = \frac{(1-\alpha_3) \left(K \left[\frac{P_2^* \alpha_2^2 (1-\alpha_2)^{1-\alpha_2} A_2}{P_1^* \alpha_1^2 (1-\alpha_1)^{1-\alpha_1} A_1} \right]^{\frac{1}{\alpha_2-\alpha_1}} + L \right) \bar{t}}{\left[(1+\bar{t})(1-\frac{1}{V(1-\tau^g)}) + m^g(\tau^g) \right]^2} \left[\frac{1+\bar{t}}{Vg(1-\tau^g)^2} - \frac{\partial m^g}{\partial \tau^g} \right] = 0, \quad (26)$$

and

$$L_3^g = \frac{(1-\alpha_3) \left(K \left[\frac{P_2^* \alpha_2^2 (1-\alpha_2)^{1-\alpha_2} A_2}{P_1^* \alpha_1^2 (1-\alpha_1)^{1-\alpha_1} A_1} \right]^{\frac{1}{\alpha_2-\alpha_1}} + L \right) \bar{t}}{(1+\bar{t})(1-\frac{1}{Vg(1-\tau^g)}) + m^g(\tau^g)}.$$

In order to simplify the analysis, we assume that nationalization only has a first-order effect on the intensity of supervision, that is,

$$m^g(\tau) = m(\tau) - \delta$$

where δ measures the effect of nationalization on the intensity of supervision. δ is nonnegative. Therefore we approximately have that $L_3^g > L_3^*$ if and only if

$$\begin{aligned} & m^g(\tau^g) - m(\tau^*) - (1+\bar{t}) \left[\frac{1}{Vg(1-\tau^g)} - \frac{1}{V(1-\tau^*)} \right] \\ & \approx \frac{1+\bar{t}}{1-\tau^g} \left(\frac{1}{V} - \frac{1}{Vg} \right) - \delta < 0 \end{aligned}$$

Therefore we have the following proposition (proof in the text):

Proposition 5:

Suppose assumptions (A1) and (A2) and condition (SC) hold. Then when

$$\theta > \frac{\bar{t}}{(1+\bar{t})(1-\frac{1}{V(1-\tau^*)}) + m(\tau^*)},$$

and

$$\delta > \frac{1+\bar{t}}{1-\tau^g} \left(\frac{1}{V} - \frac{1}{Vg} \right)$$

it is necessary for the government to increase the size of Sector 3 by depriving producers in Sector 3 of autonomy in production.

6. Conclusion

In this paper, we show that if the government wants to develop an industry that is not consistent with the comparative advantages of its economy, enterprises in the CAD industry will be non-viable and the government will be obliged to provide them with subsidies and protection. If the size of the targeted CAD industry is small, the use of taxation and subsidization will suffice to achieve the government's goal. However, if the industry is large, other policy distortions will be necessary. There is therefore a positive relationship between the degree of economic distortions and the degree of deviation of the CAD strategy from the optimal industrial structure determined by the country's endowment structure. The logic in this paper provides a consistent explanation for the origin of various institutional distortions observed in many developing countries that adopted the import-substitution, capital-intensive, heavy-industry-oriented development strategy, which went against the comparative advantage of their economies.

Appendix: Proof of Proposition 1

We only give the proofs for Case 1 and Case 2 of Proposition 1. Proofs for the other cases are similar.

Given (w, r) , using (6) and (7) we have

$$\begin{aligned} (Y_1, Y_2, Y_3) \in \operatorname{argmax} \quad & \sum_{i=1}^3 \left(P_i^* - \frac{w^{1-\alpha_i} r^{\alpha_i}}{\alpha_i^{\alpha_i} (1-\alpha_i)^{1-\alpha_i} A_i} \right) Y_i, \\ \text{subject to} \quad & Y_1 \geq 0, Y_2 \geq 0, Y_3 \geq 0. \end{aligned}$$

The Lagrangian function is

$$\mathcal{L} = \sum_{i=1}^3 \left(P_i^* - \frac{w^{1-\alpha_i} r^{\alpha_i}}{\alpha_i^{\alpha_i} (1-\alpha_i)^{1-\alpha_i} A_i} \right) Y_i.$$

The solution to this problem is given by the following optimal conditions

$$\left(P_i^* - \frac{w^{1-\alpha_i} r^{\alpha_i}}{\alpha_i^{\alpha_i} (1-\alpha_i)^{1-\alpha_i} A_i} \right) \leq 0, Y_i \geq 0,$$

and

$$\left(P_i^* - \frac{w^{1-\alpha_i} r^{\alpha_i}}{\alpha_i^{\alpha_i} (1-\alpha_i)^{1-\alpha_i} A_i} \right) Y_i = 0 \quad i = 1, 2, 3$$

Proof of Case 1

If $Y_1 > 0, Y_2 = Y_3 = 0$, then $K_1 = K, L_1 = L, K_2 = K_3 = L_2 = L_3 = 0$. In addition, we have

$$P_1^* = \frac{w^{1-\alpha_1} r^{\alpha_1}}{\alpha_1^{\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1}, \quad (27)$$

and

$$P_i^* \leq \frac{w^{1-\alpha_i} r^{\alpha_i}}{\alpha_i^{\alpha_i} (1-\alpha_i)^{1-\alpha_i} A_i} \quad i = 2, 3 \quad (28)$$

Factor prices (w, r) are given by (5) and (27) as

$$\frac{w}{r} = \frac{K}{L} \frac{1-\alpha_1}{\alpha_1}, \quad (29)$$

and

$$\begin{aligned} w &= P_1^* \alpha_1^{\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1 \left(\frac{w}{r} \right)^{\alpha_1} \\ &= P_1^* \alpha_1^{\alpha_1} (1-\alpha_1)^{1-\alpha_1} A_1 \left(\frac{K}{L} \frac{1-\alpha_1}{\alpha_1} \right)^{\alpha_1} \\ &= P_1^* (1-\alpha_1) A_1 \left(\frac{K}{L} \right)^{\alpha_1} \end{aligned} \quad (30)$$

Substituting (29) and (30) into (28), we have

$$\begin{aligned}
P_i^* \alpha_i^{\alpha_i} (1 - \alpha_i)^{1 - \alpha_i} A_i &\leq P_1^* (1 - \alpha_1) A_1 \left(\frac{K}{L} \right)^{\alpha_1} \left(\frac{K}{L} \frac{1 - \alpha_1}{\alpha_1} \right)^{-\alpha_i} \\
\frac{K}{L} &\leq \left[\frac{P_i^* \alpha_i^{\alpha_i} (1 - \alpha_i)^{1 - \alpha_i} A_i}{P_1^* \alpha_1^{\alpha_1} (1 - \alpha_1)^{1 - \alpha_1} A_1} \right]^{\frac{1}{\alpha_1 - \alpha_i}} \quad i = 2, 3 \quad (31)
\end{aligned}$$

It is straightforward by assumption (A1) that

$$\left[\frac{P_2^* \alpha_2^{\alpha_2} (1 - \alpha_2)^{1 - \alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1 - \alpha_1)^{1 - \alpha_1} A_1} \right]^{\frac{1}{\alpha_1 - \alpha_2}} < \left[\frac{P_3^* \alpha_3^{\alpha_3} (1 - \alpha_3)^{1 - \alpha_3} A_3}{P_1^* \alpha_1^{\alpha_1} (1 - \alpha_1)^{1 - \alpha_1} A_1} \right]^{\frac{1}{\alpha_1 - \alpha_3}}.$$

Thus while the endowment structure satisfies the condition

$$k \leq \left[\frac{P_2^* \alpha_2^{\alpha_2} (1 - \alpha_2)^{1 - \alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1 - \alpha_1)^{1 - \alpha_1} A_1} \right]^{\frac{1}{\alpha_1 - \alpha_2}},$$

we have $Y_1 > 0$, and $Y_2 = Y_3 = 0$.

Proof of Case 2

If $Y_3 = 0, Y_1 > 0, Y_2 > 0$, then $K_3 = 0, L_3 = 0$, and $K_1 + K_2 = K, L_1 + L_2 = L$.

Similarly, we have

$$P_i^* = \frac{w^{1 - \alpha_i} r^{\alpha_i}}{\alpha_i^{\alpha_i} (1 - \alpha_i)^{1 - \alpha_i} A_i}, \quad i = 1, 2 \quad (32)$$

and

$$P_3^* \leq \frac{w^{1 - \alpha_3} r^{\alpha_3}}{\alpha_3^{\alpha_3} (1 - \alpha_3)^{1 - \alpha_3} A_3}. \quad (33)$$

Factor prices (w, r) are given by (32) as

$$\frac{w}{r} = \left[\frac{P_2^* \alpha_2^{\alpha_2} (1 - \alpha_2)^{1 - \alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1 - \alpha_1)^{1 - \alpha_1} A_1} \right]^{\frac{1}{\alpha_1 - \alpha_2}}, \quad (34)$$

and

$$\begin{aligned}
w &= P_1^* \alpha_1^{\alpha_1} (1 - \alpha_1)^{1 - \alpha_1} A_1 \left(\frac{w}{r} \right)^{\alpha_1} \\
&= \frac{P_1^* \alpha_1^{\alpha_1} (1 - \alpha_1)^{1 - \alpha_1} A_1}{\left[\frac{P_2^* \alpha_2^{\alpha_2} (1 - \alpha_2)^{1 - \alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1 - \alpha_1)^{1 - \alpha_1} A_1} \right]^{\frac{\alpha_1}{\alpha_2 - \alpha_1}}}. \quad (35)
\end{aligned}$$

Note that given (34) and (35), (33) holds under assumption (A1). According to (5), (34), and the resource constraints, resource allocation (K_1, K_2, L_1, L_2) boils down to the solution of a set of equations:

$$\begin{aligned} L_1 + L_2 &= L, \\ K_1 + K_2 &= K, \\ K_1 - \frac{\alpha_1}{1 - \alpha_1} \left[\frac{P_2^* \alpha_2^{\alpha_2} (1 - \alpha_2)^{1 - \alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1 - \alpha_1)^{1 - \alpha_1} A_1} \right]^{\frac{1}{\alpha_1 - \alpha_2}} L_1 &= 0, \\ K_2 - \frac{\alpha_2}{1 - \alpha_2} \left[\frac{P_2^* \alpha_2^{\alpha_2} (1 - \alpha_2)^{1 - \alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1 - \alpha_1)^{1 - \alpha_1} A_1} \right]^{\frac{1}{\alpha_1 - \alpha_2}} L_2 &= 0. \end{aligned}$$

The results of employment are

$$\begin{aligned} L_1 &= \frac{(1 - \alpha_1)(1 - \alpha_2)}{\alpha_2 - \alpha_1} \left\{ \frac{\alpha_2}{1 - \alpha_2} L - K \left[\frac{P_2^* \alpha_2^{\alpha_2} (1 - \alpha_2)^{1 - \alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1 - \alpha_1)^{1 - \alpha_1} A_1} \right]^{\frac{1}{\alpha_2 - \alpha_1}} \right\}, \\ L_2 &= \frac{(1 - \alpha_1)(1 - \alpha_2)}{\alpha_2 - \alpha_1} \left\{ K \left[\frac{P_2^* \alpha_2^{\alpha_2} (1 - \alpha_2)^{1 - \alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1 - \alpha_1)^{1 - \alpha_1} A_1} \right]^{\frac{1}{\alpha_2 - \alpha_1}} - \frac{\alpha_1}{1 - \alpha_1} L \right\}. \end{aligned}$$

As $L_1 > 0$, and $L_2 > 0$, we obtain immediately

$$\left[\frac{P_2^* \alpha_2^{\alpha_2} (1 - \alpha_2)^{1 - \alpha_2} A_2}{P_1^* \alpha_1^{\alpha_1} (1 - \alpha_1)^{1 - \alpha_1} A_1} \right]^{\frac{1}{\alpha_1 - \alpha_2}} < \frac{K}{L} < \frac{\alpha_2}{1 - \alpha_2} \left[\frac{P_2^* \alpha_2^{\alpha_1} (1 - \alpha_2)^{1 - \alpha_1} A_2}{P_1^* \alpha_1^{\alpha_1} (1 - \alpha_1)^{1 - \alpha_1} A_1} \right]^{\frac{1}{\alpha_1 - \alpha_2}}.$$

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